Page 5, after line 19, insert the following list that currently appears on pages 43-44 of the original specification:

Advantageous features of preferred exemplary embodiments include:

- Identifying coordinates on 2D image to be mapped to triangles that form a 3D face;
- Still image editor for user of a video game;
- Image editor that allows editing of image in 2D and 3D modes;
- 2D image editing while 3D mapped image is being displayed in real time to show effect of editing;
- Selection of various 3D heads on which to map a 2D image, and manipulation of those 3D heads to improve appearance of 2D face mapped on the head;
- 3D head manipulation of both front view shape and front-to-back distance of head;
- Portable storage of a personalized game player;
- Random placement of personalized game player faces onto computer controlled players, such as guards;
- Mapping of 2D image on 3D face;
- Using a digital camera mounted on a hand controller to take pictures for a game console;

- Using a digital camera mounted on one hand controller where a 2D image capture memory resides in the digital camera, and a memory for storing a 3D head mapped with the 2D image is attached to the same or another hand controller;
- Personalize game player having a face of the user.

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The paragraph beginning at page 7, line 18:

FIGURE 15 is an exemplary video game screen image showing a 2D facial image mapped on a head and a prompt to save this personalized head;

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The paragraph beginning at page 8, line 9:

FIGURES 20 and 21 are exemplary video game screen images of an image editor having controls for manipulating the shape of a 3-D head, and

A3

The paragraph beginning at page 8, line 14:

Fig. 1 is a block diagram of a game system according to one embodiment of the present invention. The machine is, for example, a game machine 10 (e.g., the product "Nintendo 64") utilizing an advanced technology, such as 32 or 64 bits, which is high in processability (i.e., processing capability , for example, in CPU bit number, CPU program processing capability per unit time or image representability). The machine uses a removable memory cartridge 12 (hereinafter referred to as "cartridge") as one example of an external memory medium for storing game programs, and other data.

A4

The paragraph beginning on page 9, line 1:

Controllers 16a, 16b, such as hand controllers, are electrically connected to the machine 10 typically via wires 17, although a wireless connection may be used. The hand controller has a joystick, buttons, keys and other user input devices for interactively controlling game play as displayed on a television 18. In addition, the hand controller includes an electrical connector 24 which provides a data connection between a removable data transfer pack 26 plugged into the controller and a processor in the game machine. A transfer cartridge is disclosed in pending U.S. Patent Application Serial No. 09/189,797, entitled "Game System Operable With Backup Data On Different Kinds of Game Machines" and filed November 12, 1998, and the entire contents of which is incorporated by reference. The data transfer pack includes a connector 28 for electrically connecting to other game cartridges, a memory pack cartridge or to a cartridge with digital camera 14, as is disclosed in pending U.S. Patent Appln. Serial No. 09/430,169, entitled "Portable Game Machine Having Image Capture, Manipulation and Incorporation" filed October 29, 1999, the entire contents of which is incorporated by reference. The digital camera cartridge 14 may be used in connection with the transfer cartridge 26 to interface the digital camera cartridge to the machine, via the transfer pack and controller. An advantage of inserting the digital camera cartridge into a hand-held controller is that a user may easily align the field of view of the camera with a desired subject simply by holding and positioning the controller and camera. In addition, a

A5

digital camera cartridge may be inserted into a connector of the controller, while at the same time a game cartridge 12 having an image editor and game program may be inserted in a cartridge connector of the machine. In addition, the digital camera may be inserted into a first hand controller 16a, and a second hand controller 16b may be used to input user control information for capturing, editing and saving an image and to connect to a memory pack (not shown in Figure 1) for storing data regarding the image and associated personalized 3D head of an animated game player.

The paragraph beginning on page 10, line 14:

FIGURE 2 is an exploded view showing the structure of a camera cartridge 14. The camera portion is integrally formed on the upper portion (upper edge) when viewed from the front of the housing 50a, 50b, which contains an electrical circuit having electronics to support the digital camera, memory for storage of 2D digital images and a connector 54 for coupling the camera cartridge to a game machine and data pack. The housing is formed, for example, in a flat, vertically elongated rectangular parallelepiped shape having a prescribed thickness. The connector 54 is provided inside an opening in the cartridge housing 50 a, b, opening for contacting with a terminal (e.g., edge connector) of a substrate 52 included in the cartridge to electrically connect a circuit on the substrate to an electric circuit in the housing. The camera cartridge 14 includes a generally spherical camera housing 20a, 20b containing an image pickup device, e.g., lens 22 and CCD 30, and is supported rotatably (in a lateral direction when viewed from

A6

the front by the supporting portion) on a mounting 32a, 32b on the housing of the cartridge.

The paragraph beginning on page 11, line 21:

In this manner, the supporting portion rotatably supports the camera portion in a lateral direction of the body portion to allow the user to easily change the shooting range by simply changing the direction of the camera portion and also to shoot and display the forward direction of the user and the user himself/herself (or the backward direction of the user) on the image display device when the rotation range is selected to approximately 180 degrees. Further, the supporting axis with which the supporting

A7

portion supports the camera portion is inclined to allow the user to freely adjust the shooting range in the forward direction or on the user side by only slightly including both wrists when holding the housing with both hands, without requiring the user to take an uncomfortable position when adjusting, thereby reducing the fatigue of the wrists.

The paragraph beginning on page 12, line 14:

The game machine 120 includes a CPU 121 that is connected to an input/output interface 122 (hereinafter referred to as "I/O"). To the I/O are connected connectors 123b, 123d for connection with a hand controller 124. Where the game machine 120 is

A8

usable for a game in which a plurality of players participate at a same time, a plurality of sets of connectors and controllers are provided. The hand controller 124 may also include a connection 150 to a portable memory pack 115, having a read/write memory for

storage of user data, e.g., facial images, to be used during game play. The memory cartridge connectable to the hand controller incorporates, by mounting on a substrate, a non-volatile memory (e.g., ROM, EP-ROM; hereinafter referred to as "ROM") for storing image files, editing files and identification codes.

A8

The paragraph beginning at page 13, line 15:

FIGURE 4 is a block diagram of the components for capturing an image of a subject 300, e.g., a face of a person. Light reflected off of the subject towards the digital camera cartridge 304 is focused by a lens 302 on a charged-coupled-semiconductor device (CCD) 306. The CCD generates electrical signals representing an image of the subject. An analog-to-digital converter 308 converts the electrical signals into a digital image of the subject. The digital image is formatted by another converter 310 into a digital file that is stored in a RAM memory 312 in the camera cartridge 304. The memory 312 may save several digital image files representing different pictures. In addition, these image files can be written into memory over existing files, so as to erase those overwritten image files.

A9

The paragraph beginning on page 16, line 3:

During image capture, an oval template 1004 is displayed on the screen to prompt the user to center his face in image capture area. During the "Take Picture" menu (Fig. 10) the current visual image as being received by the camera is displayed on screen, and is updated by the camera at around 2 times per second. A blue transparent overlay

A10

template 1004 highlights a vertical oval area of the image which is deemed to be the ideal position for the user to position his or her face. Face images that fit correctly with this A10 oval will need little fine tuning and as such the whole capture/editing process is speeded up by properly positioning the user's face in the oval. The user moves before the camera so that his head is centered in the oval template shown in real-time on the screen.

The paragraph beginning on page 17, line 7:

A facial image may also be selected by choosing one of the stored 2D images in the camera cartridge (Fig. 9) or by choosing a personalized 3D animated game player stored in a game pack or other memory device coupled to the game pack, controller or A11 machine. If a personalized 3D head is selected (S64), the user may be first prompted to identify the game mode, e.g., multi-player combat, single player missions or both, in step S66. The user is then presented on the display with the 3D personalized heads for selection in S68. The user may then begin game play or edit (S70, S72, S74) the existing head.

The paragraph beginning at page 17, line 21:

Once a pre-existing image is selected, the image is transferred from the camera memory to memory in the game machine, in step S80. Regardless of whether the image is a pre-existing image or an image captured from a real-time camera image, the program A12 saves the image in temporary memory in the game machine so that the image may be applied to a head and edited, in step S82. The mapping of a 2D image onto the head may

occur during start-up of each game (as the existing heads are readout of the memory pack) and, during the editing process, as 3D heads and 2D facial images are being edited. The major portions of each 3D head are its face, hair and sides (neck and sides around the ears). The two-dimensional facial image 1200 is mapped to the face portion 1204 of the 3D head 1206, as is shown in FIGURE 12. The hair 1206 and sides 1208 of the head are not mapped with a 2D image. The 3D face area 1202 is a 3D generally oval surface. This face area surface is defined mathematically by computer software as triangles, e.g., 20 triangles, that when assembled together form a 3D surface of the face of the head. To generate a 3D face, to be inserted in a head that may be oriented from the front, side, looking-up, looking down or other point of view, the computer determines the location and position of each of the triangles that define the face. The location in three-dimensions of the surface of the face is determined, determining the location of each of the mathematically defined triangles that form the 3D face image.

The paragraph beginning at page 18, line 18:

The 2D facial image is applied to the 3D face by mapping the 2D image to the triangles that form the 3D face. For mapping, the 2D image is segmented into triangular sections that correspond to the 3D triangles of the face. The segmentation is done by identifying three points on the 2D image that correspond to the corners of each triangle of the 3D face. The section of the 2D image within the triangle defined by each of the three identified points is mapped onto the corresponding triangle of the 3D face. For example,

one of the triangles of the 3D face portion may correspond to the nose of the face. To map the nose of the 2D image to the 3D nose triangle, three points on the 2D image are identified that outline the nose shown in that 2D image. The 2D image within the

A13 triangle defined by the three selected points are mapped to the triangle corresponding to the nose of the 3D face. Similarly, the other triangular sections' 2D image are mapped to the other triangles that make up the 3D face. The mapping of the 2D image onto a 3D face is accomplished each time the video game starts up and during editing.

The paragraph beginning at page 20, line 24:

To calculate the transformed (texture) co-ordinates, equations 4 and 5 are applied to each

A14 vertex, S1310, S1312, S1314 and S1316.

The paragraph beginning at page 21, line 8:

The stored 3D "heads" which the user selects are stored in the game program (or memory controller pack) as "slots" S82. When completed, the one slot contains all the information to generate a custom character head. This includes face texture information, hair and face colors, head type, etc. The game allows multiple slots for multiple heads

A15 that can be used in the single player version of the game where the custom heads can be used for either your player character's head or that of a random guard or other computer-controlled game character.

The paragraph beginning at page 22, line 6:

Once a facial image has been selected, the user is prompted to apply the image to an animated three-dimensional head, in step 568 and shown in FIGURE 15. The machine may have stored several, e.g., five, animated 3D heads which are used to create animated game players. These heads may be male or female, and have different shapes, hair color and skin tone. The heads are presented on the display as individual 3D head images. The heads may have blank faces, a computer generated face or have the face of the 2D facial image that has been captured and selected for use in creating a personalized head. The heads may move, e.g., turn from side to side and tilt up and down, so that the user may see the head from different angles. The user selects a head on which to apply the facial image that has been captured.

A16

The paragraph beginning at page 23, line 14:

To edit an animated 3D head with a mapped 2D facial image, the user selects one of several available editing functions, including select a new 2D facial image S86, select a new 3D head S88, reposition the 2D facial image S90, adjust the 3D shape of the head S92, change the hair color and skin tone of the head S94, delete the saved head S96, cancel any changes S98 that have been made to a saved head during the editing process, and save any changes made to the head and facial image S100.

A17

The paragraph beginning at page 23, line 21:

In particular, the editor contains various sections to alter the characteristics of the current head, these including:

Take Another Picture (S86)

This option leads to the "Take Picture" menu allowing the user to change the image that is mapped onto the head's face.

Change Head (S88)

The "Change Head" function allows the user to alter his or her choice of the special face mapping enabled character heads.

A18

Position Picture (S90)

This menu allows the user to change which parts of the captured image are mapped onto the head's face. Five control handles allow the size, shape and position of the aforementioned oval area to be altered, as is shown in FIGURE 19. The software maps the 2D image that falls inside this oval onto the facial area of the head. An additional "Brightness" feature allows the user to change the brightness of the facial image helping to disguise the joint between the face and the rest of the head.

The paragraph beginning at page 24, line 15:

The editing by the user of the captured 2D image S90 includes: adjusting the position of the oval template over the 2D image, expanding and contracting the oval

A19

shape about the major and minor axes (length and width) of the oval, and adjusting the brightness of the 2D image 1900 in Fig. 19. The oval template 1902 defines the portion of the 2D image that will be mapped to the 3D face. The template is translucent so that the entire 2D image (both inside and out of the template) may be viewed -- which facilitates the positioning of the template on the 2D image. The template can be moved with respect to the 2D image by use of cursor commands and drag points that are on the rim of the oval and that can be manipulated by the user with the hand controller and a cursor that appears on the image in Figure 19.

A19

The paragraph beginning at page 25, line 3:

Moving the template with respect to the image allows the user to better align his face in the oval template and, thereby, adjusts the alignment of the facial image on the 3D head 1904. Expanding and contracting the length and width of the oval also allows a user to better position his facial image within the oval and, thus, onto the 3D face.

A20

The paragraph beginning at page 25, line 19:

The 2D image editor may also automatically balance the contrast of the image to reduce the unintended effects of shading on the 2D image. These shading effects can cause poor 3D visual effects when the 2D image is mapped on the 3D face. To balance the contrast, the image editor compares the brightness of the left side of the image to the right side of the image. If the brightness between the two sides varies excessively, such as by more than 10%, then the editor reduces the brightness on the bright side of the

A21

image and may increase the brightness on the dark side of the image. In addition, the brightness/darkness adjustments are more pronounced at the edges of the oval image than at the center because the brightness adjustments are applied in a linear manner in which the center of the image is not adjusted so as to avoid creating a perceptible contrast change at the center of the image.

A21

The paragraph beginning at page 26, line 8:

When using a digital camera to take an image in "real" world conditions, it is often found that the brightness of the image is not consistent across the image when measured from left to right. This can create problems with face image mapping as the brightness of the join line at each side of the head is at the same brightness. The join line is the 3D surface line where the face portion of the head meets the sides of the face. If there is a difference in brightness at the join line, the result is a distinct and unwanted shade discontinuity on one or both sides of the mapped head.

A22

The paragraph beginning at page 26, line 16:

In order to combat this effect, "Automatic Shade Compensation" techniques are used during the mapping phase of the operation. This attempts to modify the brightness of the 2D-captured image to give a more even mapping without unduly affecting the "look" of the overall image.

A23

The paragraph beginning at page 26, line 20:

This is achieved by applying a non-linear filter to the 2D image, which modifies the intensity of each pixel as a function of pixel position and based upon the following

A24

equations. This filter is applied to the whole image, however only pixels within the oval are used to calculate the filter parameters:

The paragraph beginning at page 27, line 3:

N_{Summed} = Number of pixels used in the summation (i.e. Fall within 25%

A25

and 75% bounds)

The paragraph beginning at page 28, line 11:

Note that at $x=N_x/2$ no intensity changes occur on either side thus preventing a

A26

discontinuity from appearing at the center of the image.

The paragraph beginning at page 28, line 19:

Shape Head (S92)

The "Shape Head" feature allows the user to alter the three dimensional shape of the current head as is shown in FIGURES 20 and 21. Control points allow the head to be squashed and stretched in dimensions coplanar to the face and an

A27

additional slider allows the depth of the head or scale in the front to back direction to be altered.

The paragraph beginning at page 30, line 4:

Keep Changes (S100)

Keeping changes updates the current selected slot with the alterations made during the editing session. Following this the user is again invited to save his or her work to a controller pack.

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The paragraph beginning at page 20, line 8:

The personalized heads that were created using the image capture/edit/save functions may be used during game play. Typically, a user will select a personalized head that includes the user's facial image and applies that head to the body of a desired animated game character. In this way, users can personalize game play by having the animated player that they control be a player that has the appearance of the user. During multiple-user combat game play, it would enhance the realism of game play if the animated game players appear in multi-player game mode.

A29

The paragraph beginning at page 30, line 16:

Moreover, the personalize heads may be applied (in a random manner or some prescribed manner, e.g., all guards have a certain head) to computer controlled game characters, such as guards that appear in a combat game, where the guards are not controlled by any of the game playing users. During game play, any heads that occupied the "Single Player Slots" are randomly selected and used as the heads for that particular level's guard characters. Thus, the user will see personalized computer generated players

A30

as he plays a game. In addition, if the slots set aside for multi-player games contain any valid personalized heads then these heads may appear (Fig. 14) as a head option when the player chooses to modify his character's properties. Thus, the player may use or edit any of the saved "heads" in the controller memory pack.

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The paragraph beginning at page 31, line 4:

The 2D image and settings made with the editor are stored to save a personalized animated game player. The 2D image and settings may be stored in the user's controller memory pack so that they may be carried by the user from one game console to another. The memory pack plugs into the hand controller and may be carried by the user from game machine to game machine and, thus, allows the user to load his personalized 3D animated game player (including a face that is derived from a 2D image of the user) into any game machine that the user may be playing. Thus, some advantages of using controller game packs for storage of personalized player head is that the user can carry personalized player settings to other game consoles, especially those consoles' owned by friends. Other advantages of a portable personalized player head stored in the controller memory pack include that friends may play each other where each friend has their own personalized player, and personalized images may be formed for the computer controlled players, e.g., automatically generated guards and other "bad guys" to randomly have personalized heads appear on animated figures during the game.

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